What Is Claimed Is:

1. A system which comprises a first reactor which produces a hydrogen-rich gas stream containing carbon monoxide (CO), and an apparatus for removing the carbon monoxide from the hydrogen-rich gas stream, the apparatus comprising: a vessel housing an adsorbent adapted to adsorb the carbon monoxide.

2. The system as defined in claim 1 wherein the vessel is a pressure swing adsorber.

3. The system as defined in claim 2 wherein the pressure swing adsorber comprises multiple, staged fixed beds.

4. The system as defined in claim 2 wherein the pressure swing adsorber is a rotating vessel.

5. The system as defined in claim 4 wherein the rotating vessel comprises:

an adsorption region;
a depressurization region;
a purge region; and
a pressurization region.

6. The system as defined in claim 4 wherein the rotating vessel comprises two fixed valve faces.

7. The system as defined in claim 1 which is a fuel cell system.

8. The system as defined in claim 1 wherein the adsorbent is selected from the group consisting of 5A zeolite, 13X zeolite, and mixtures thereof.

9. The system as defined in claim 1 wherein the adsorbent is selected from the group consisting of: oxides or salts of copper impregnated or exchanged on activated carbon, alumina, and zeolites; oxides or salts of silver impregnated or exchanged on activated carbon, alumina, and zeolites; oxides or salts of tin impregnated or exchanged on activated carbon, alumina, and zeolites; and mixtures thereof.

10. The system as defined in claim 9 wherein, upstream of the carbon monoxide adsorbent, the vessel comprises a layer of a desiccant material.

11. The system as defined in claim 10 wherein the desiccant material is selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof.

12. The system as defined in claim 1 wherein the adsorbent is a first adsorbent, and wherein the apparatus further comprises a second reactor which is a water gas shift reactor disposed between the first reaction and the vessel.

13. The system of claim 12 wherein the water gas shift reactor includes a second adsorbent adapted to adsorb carbon monoxide.

14. The system of claim 12 wherein the water gas shift reactor is a high temperature water gas shift reactor.

15. The system as defined in claim 12 wherein the second adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures.

16. The system as defined in claim 1 which further comprises an expander downstream of the vessel, and wherein the expander provides a purge gas to be fed back into the vessel.

17. The system as defined in claim 16 which further comprises a fuel cell stack having an anode exhaust, the fuel cell stack disposed between the vessel and the expander, and wherein the expander expands the anode exhaust, the expanded anode exhaust providing the purge gas to be fed back into the vessel.

18. The system as defined in claim 16 wherein the vessel is a rotating vessel, and wherein the expander is an isothermal expander adapted to provide electrical power for driving the rotating vessel.

19. The system as defined in claim 2 wherein the hydrogen fuel cell system includes a low pressure steam stream, and wherein the steam stream provides a purge gas to be fed into the vessel.

20. A system which comprises a first reactor which produces a hydrogen-rich gas stream containing CO, and an apparatus for removing the carbon monoxide (CO) from the hydrogen-rich gas stream, the apparatus comprising:

a rotating vessel housing a first adsorbent adapted to adsorb the carbon monoxide, wherein the rotating vessel is a pressure swing adsorber and comprises two fixed valve faces, and wherein the rotating vessel further comprises:

an adsorption region;

a depressurization region;

a purge region; and

a pressurization region; and

a second reactor which is a water gas shift reactor disposed between the first reactor and the vessel, wherein the water gas shift reactor includes a second adsorbent adapted to adsorb carbon monoxide, wherein the second adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures.

21. The system as defined in claim 20 wherein the system further comprises an expander downstream of the vessel, and wherein the expander provides a purge gas to be fed back into the vessel.

22. The system as defined in claim 21 wherein the system is a hydrogen fuel cell system further comprising a fuel cell stack having an anode exhaust, the fuel cell stack disposed between the vessel and the expander, and wherein the expander expands the anode exhaust, the expanded anode exhaust providing the purge gas to be fed back into the vessel.

23. The system as defined in claim 21 wherein the expander is an isothermal expander adapted to provide electrical power for driving the rotating vessel.

24. The system as defined in claim 20 wherein the system includes a low pressure steam stream, and wherein the steam stream provides a purge gas to be fed into the vessel.

25. The system as defined in claim 20 wherein the first adsorbent is further adapted to adsorb at least one of carbon dioxide and water from the hydrogen-rich gas stream.

26. The system as defined in claim 25 wherein the first adsorbent is selected from the group consisting of 5A zeolite, 13X zeolite, and mixtures thereof.

27. The system as defined in claim 20 wherein the adsorbent is selected from the group consisting of oxides or salts of copper impregnated or exchanged on activated carbon, alumina, and zeolites; oxides or salts of silver impregnated or exchanged on activated carbon, alumina, and zeolites; oxides or salts of tin impregnated or exchanged on activated carbon, alumina, and zeolites; and mixtures thereof.

28. The system as defined in claim 27 wherein, upstream of the first carbon monoxide adsorbent, the vessel comprises a layer of a desiccant material selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof.

29. The system as defined in claim 7 wherein a preferential oxidizer (PROX) is eliminated from the hydrogen fuel cell system.

30. The system as defined in claim 22 wherein a preferential oxidizer (PROX) is eliminated from the hydrogen fuel cell system.

31. A method for removing carbon monoxide (CO) from a hydrogen-rich gas stream produced in a first reactor, the method comprising the step of passing the hydrogen-rich gas stream through a vessel which houses an adsorbent adapted to adsorb the carbon monoxide.

32. The method as defined in claim 31 wherein the vessel is a rotating pressure swing adsorber.

33. The method as defined in claim 32, further comprising the steps of:

pressurizing the vessel before the passing of the hydrogen-rich gas stream through the vessel;

depressurizing the vessel after the passing of the hydrogen-rich gas stream through the vessel; and

purging the vessel with a gas having a low carbon monoxide concentration.

34. The method as defined in claim 31 wherein the hydrogen-rich gas stream is not passed through a preferential oxidizer (PROX).

35. The method as defined in claim 31 wherein the adsorbent is a first adsorbent, and wherein the method further comprises the step of passing the hydrogen-rich gas stream through a second reactor which is a water gas shift reactor disposed between the first reactor and the vessel.

36. The method of claim 35 wherein the water gas shift reactor includes a second adsorbent adapted to adsorb carbon monoxide.

37. The method as defined in claim 36 wherein the second adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures.

38. The method of claim 31 which in start-up mode comprises forming said hydrogen-rich stream by reacting a hydrocarbon fuel and air in the first reactor.

39. The method of claim 38 which further includes a second reactor which is a water gas shift reactor disposed between the first reactor and the vessel.

40. The method of claim 38 wherein after the start-up mode, steam is reacted along with the hydrocarbon fuel and air in the first reactor.

41. A method for removing carbon monoxide from a hydrogen-rich gas stream produced in a first reactor, the method comprising the steps of:

passing the hydrogen-rich gas stream through a vessel which houses an adsorbent adapted to adsorb the carbon monoxide to provide a reduced CO content, wherein the vessel is a rotating pressure swing adsorber;

pressurizing the vessel before the passing of the hydrogen-rich gas stream through the vessel;

depressurizing the vessel after the passing of the hydrogen-rich gas stream through the vessel; and

purging the vessel with a gas having a low carbon monoxide concentration.

42. The method as defined in claim 41 wherein the adsorbent is a first adsorbent, and wherein the method further comprises the step of passing the hydrogen-rich gas stream through a second reactor which is a high temperature water gas shift reactor disposed between the first reactor and the vessel, wherein the water gas shift reactor includes a second adsorbent adapted to adsorb carbon monoxide.

43. The method as defined in claim 42 wherein the second adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures.

44. The method as defined in claim 41 wherein the hydrogen-rich gas stream is not passed through a preferential oxidizer (PROX).

45. The method of claim 41 which is conducted in a fuel cell system having a fuel cell stack, and wherein the hydrogen-rich gas stream having the reduced CO content is reacted in the fuel cell stack.